## **CADMIUM**

(Data in metric tons of cadmium content unless otherwise noted)

<u>Domestic Production and Use</u>: Two companies in the United States produced refined cadmium in 2015. One company, operating in Tennessee, recovered primary refined cadmium as a byproduct of zinc leaching from roasted sulfide concentrates. The other company, operating in Ohio, recovered secondary cadmium metal from spent nickel-cadmium (NiCd) batteries and other cadmium-bearing scrap. Domestic production and consumption of cadmium from 2011 to 2015 were withheld to avoid disclosing company proprietary data. Cadmium metal and compounds are mainly consumed for alloys, coatings, NiCd batteries, pigments, and plastic stabilizers.

Salient Statistics—United States:	2011	2012	2013	2014	2015 <sup>e</sup>
Production, refined <sup>1</sup>	W	W	W	W	W
Imports for consumption:					
Unwrought cadmium and powders	201	170	284	133	270
Wrought cadmium and other articles (gross weight)	9 ( <sup>2</sup> )	21	104	6	20
Cadmium waste and scrap (gross weight)	( <sup>2</sup> )	1	( <sup>2</sup> )		80
Exports:					
Unwrought cadmium and powders	63	253	131	198	290
Wrought cadmium and other articles (gross weight)	204	378	266	72	120
Cadmium waste and scrap (gross weight)	5	_	20		
Consumption of metal, apparent <sup>3</sup>	W	W	W	W	W
Price, metal, annual average,4 dollars per kilogram	2.76	2.03	1.92	1.94	1.05
Stocks, yearend, producer and distributor	W	W	W	W	W
Net import reliance <sup>5</sup> as a percentage of					
apparent consumption	<25%	E	<25%	Е	Е

**Recycling:** Secondary cadmium is mainly recovered from spent consumer and industrial NiCd batteries. Other waste and scrap from which cadmium can be recovered includes copper-cadmium alloy scrap, some complex nonferrous alloy scrap, and cadmium-containing dust from electric arc furnaces (EAF). The amount of cadmium recovered from secondary sources in 2015 was withheld to avoid disclosing company proprietary data.

Import Sources (2011-14): Canada, 40%; Australia, 17%; China, 11%; Mexico, 10%; and other, 22%.

Tariff: Item	Number	Normal Trade Relations <sup>7</sup> 12–31–15
Cadmium oxide	2825.90.7500	Free.
Cadmium sulfide	2830.90.2000	3.1% ad val.
Pigments and preparations based		
on cadmium compounds	3206.49.6010	3.1% ad val.
Unwrought cadmium and powders	8107.20.0000	Free.
Cadmium waste and scrap	8107.30.0000	Free.
Wrought cadmium and other articles	8107.90.0000	4.4% ad val.

**Depletion Allowance:** 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

<u>Events, Trends, and Issues</u>: Most of the world's primary cadmium metal was produced in Asia, The leading global producers were China, the Republic of Korea, and Japan. Secondary production accounted for about 20% of global production. Cadmium was consumed primarily in Belgium, China, India, and Japan. NiCd battery production accounted for more than 80% of global cadmium consumption, and the remainder was used, in order of descending consumption, in pigments, coatings and plating, stabilizers for plastics, nonferrous alloys, and other specialized uses.

The average annual cadmium price declined for the fourth consecutive year, decreasing by 46% in 2015 from that of 2014 to about \$1.05 per kilogram. The price began the year averaging \$1.76 per kilogram in January and fell to an average of \$0.79 per kilogram by September. Decreasing prices were attributed to an oversupply of cadmium in the market, reduced demand in India, and a decline in nickel-cadmium battery production in China because an increase in domestic environmental regulations resulted in several facility closures.

In mid-June, a U.S.-based solar cell manufacturer announced that it had improved the energy conversion efficiency of

## **CADMIUM**

its cadmium telluride (CdTe) photovoltaic modules to 18.6%, surpassing the efficiency of multicrystalline silicon modules and potentially increasing the market competitiveness of CdTe solar technology.

In October 2013, the European Parliament amended the European Union (EU) Battery Directive (2006/66/EC) to prohibit the inclusion of NiCd batteries in cordless power tools beginning December 31, 2016, after which nickel-cadmium batteries could only be used in emergency systems and medical equipment in the EU. In late 2014, cadmium fluoride and cadmium sulfate were added to the European Chemical Agency's (ECHA) candidate list of Substances of Very High Concern, requiring ECHA and the European Commission to determine whether the use of these chemicals would require special authorization under the EU's Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) legislation. In May, the European Parliament voted against extending an exemption on cadmium-containing quantum dots under the Restriction of Hazardous Substances directive. Cadmium-containing quantum dots are used in light-emitting diodes for display technologies. Despite these restrictions, cadmium-containing residues will continue to be produced as a byproduct from zinc smelting. If the applications and markets for cadmium continue to decline, excess byproduct cadmium may need to be permanently stockpiled and managed.

## **World Refinery Production and Reserves:**

-	Refinery	production	Reserves <sup>8</sup>	
	<u>2014</u>	2015 <sup>e</sup>		
United States	W	W	Quantitative estimates of reserves are	
Australia	350	380	not available. The cadmium content of	
Bulgaria	350	340	typical zinc ores averages about 0.03%.	
Canada	1,310	1,480	See the Zinc chapter for zinc reserves.	
China	7,000	8,090		
India	380	460		
Japan	1,830	1,970		
Kazakhstan	1,200	1,190		
Korea, Republic of	4,010	4,250		
Mexico	1,410	1,460		
Netherlands	640	640		
Peru	769	750		
Poland	628	640		
Russia	1,200	1,170		
Other countries	<u>1,350</u>	1,330		
World total (rounded)	<sup>9</sup> 22,400	<sup>9</sup> 24,200		

<u>World Resources</u>: Cadmium is generally recovered from zinc ores and concentrates. Sphalerite, the most economically significant zinc mineral, commonly contains minor amounts of cadmium, which shares certain similar chemical properties with zinc and often substitutes for zinc in the sphalerite crystal lattice. The cadmium mineral greenockite is frequently associated with weathered sphalerite and wurtzite. Zinc-bearing coals of the Central United States and Carboniferous age coals of other countries also contain large subeconomic resources of cadmium.

<u>Substitutes</u>: Lithium-ion and nickel-metal hydride batteries are replacing NiCd batteries in some applications. However, the higher cost of these alternatives restricts their use in less-expensive products. Except where the surface characteristics of a coating are critical (for example, fasteners for aircraft), coatings of zinc or vapor-deposited aluminum can be substituted for cadmium in many plating applications. Cerium sulfide is used as a replacement for cadmium pigments, mostly in plastics. Barium-zinc or calcium-zinc stabilizers can replace barium-cadmium stabilizers in flexible polyvinylchloride applications.

<sup>&</sup>lt;sup>e</sup>Estimated. E Net exporter. W Withheld to avoid disclosing company proprietary data. — Zero.

<sup>&</sup>lt;sup>1</sup>Cadmium metal produced as a byproduct of zinc refining plus metal from recycling.

<sup>&</sup>lt;sup>2</sup>Less than ½ unit.

<sup>&</sup>lt;sup>3</sup>Defined as domestic refined production + imports of unwrought metal and metal powders – exports of unwrought metal and metal powders + adjustments for industry stock changes.

<sup>&</sup>lt;sup>4</sup>Average New York dealer price for 99.95% purity in 5-short-ton lots. Source: Platts Metals Week (2011–2014), Metal Bulletin (2015),

<sup>&</sup>lt;sup>5</sup>Defined as imports of unwrought metal and metal powders – exports of unwrought metal and metal powders + adjustments for industry stock changes.

<sup>&</sup>lt;sup>6</sup>Imports for consumption of unwrought metal and metal powders (Tariff no. 8107.20.0000).

<sup>&</sup>lt;sup>7</sup>No tariff for Australia, Canada, Mexico, and Peru for items shown.

<sup>&</sup>lt;sup>8</sup>See Appendix C for resource/reserve definitions and information concerning data sources.

<sup>&</sup>lt;sup>9</sup>Does not include production in Algeria and the United States.